CONTROLLING PERIPHERAL DEVICE IN COMMUNICATION SYSTEM

The present invention relates to a method of controlling and supervising a peripheral device in a communication system. The invention is applicable to e.g. cellular radio systems and particularly to WLL systems (Wireless Local Loop), with reference to which the invention is herein primarily described. It is to be understood, however, that the invention is applicable in other connections as well, e.g. in a fixed telephone network.

A problem in controlling subscriber stations in communication systems is that subscriber stations often are in subscribers' possession, and so the maintenance personnel of an operator do not have easy access to them. For example in WLL systems, in which a subscriber is provided with a terminal equipment intended to be stationary, said terminal equipment is usually located fixed in its place on subscriber premises. A WLL terminal may be comprised of a radio part and a teleadapter, to which a user interface, e.g. a telephone set, a telefax terminal, a computer-modem combination or the like, is connected.

As in WLL systems the terminal equipment is on subscriber premises, the operator has to be able to supervise and control its operation via the radio path. This is necessary e.g. in reconfiguring the system, when the telecommunication settings of a subscriber station have to be adjusted to correspond to e.g. a new radio cell created in the system. Correspondingly, the operator should also be able to supervise the operation of a terminal equipment in such a way that the operator can be sure that the terminal equipment operates in the desired manner.

Known radio systems comprise a subscriber station management system, by means of which the operator can supervise and manage the operation of the subscriber stations within the system. In practice, the management system usually comprises a computer unit programmed to carry out certain supervisory routines and to receive alarms transmitted by the subscriber stations. The subscriber station management system communicates with the subscriber stations via the radio path, by means of control signals transmitted and received by the base stations of the system. For example, if an alarm goes off in a subscriber station, said subscriber station conveys this information by sending the alarm via the radio path to the base station, from where the alarm is forwarded to the subscriber station management system.

In known communication systems, a variety of peripheral devices are used. One of the peripheral devices known from radio systems is the repeater, which repeats signals of a base station to a shadow area which the signals transmitted by the base station do not otherwise reach (e.g. to the interiors of buildings). The coverage area of a base station can thus be spread to areas its signals would not otherwise reach. In order for the peripheral devices to be used in a radio system to operate in the desired manner, their management should be taken into account already in the network design. In known radio systems, a specific management system has been created for managing peripheral devices, by means of which system control signals are transmitted to the peripheral devices via the radio path. In order for peripheral devices to be able to receive control signals transmitted to them via the radio path, they have to be connected to a radio receiver. In practice, a subscriber station, to which the peripheral device is connected, is brought in contact with the peripheral device. Thus, the management system for the peripheral devices is practically in connection with the subscriber station e.g. by means of a data call or a short message, and said subscriber station in turn forwards the received control signals to the peripheral device.

A weakness of known communication systems is that the peripheral devices used in a system require their own specific management system. This makes the communication system more complicated and increases its costs due to the equipment investments required by the management system for the peripheral devices. Further, the maintenance of the management system for the peripheral devices is relatively laborious, as reconfigurations carried out in the network, for example, may require changes in the management system for peripheral devices as well.

The object of the present invention is to solve the above problem and to provide a solution by which the management of peripheral devices used in communication systems is facilitated without any need to invest heavily in equipment in order to implement the management system. This object is achieved by the method of the invention of controlling a peripheral device in a communication system comprising network elements and subscriber stations in data transmission connection with each other, and a subscriber station management system supervising and controlling the operation of the subscriber stations by control signals, and in which method said peripheral device is connected to a subscriber station. The method of the invention is character-

ized in that it comprises the steps of: arranging control means to the subscriber station for controlling and supervising the peripheral device, and controlling the peripheral device by means of the subscriber station management system by transmitting control signals from the subscriber station management system to the control means of the subscriber station, in response to which control signals the control means control and supervise the operation of the peripheral device.

The invention also relates to a communication system, to which the method of the invention can be applied, comprising subscriber stations comprising means for transmitting and receiving telecommunication signals, network elements in data transmission connection with the subscriber stations, a subscriber station management system comprising means for controlling and supervising the operation of the subscriber stations by means of the network elements, and at least one subscriber station to which a peripheral device is connected. The communication system of the invention is characterized in that the subscriber station management system comprises means for controlling and supervising the peripheral device connected to the subscriber station by means of control signals transmitted to the subscriber station.

The invention further relates to a subscriber station in a communication system comprising: means for transmitting and receiving telecommunication signals in order to set up a data transmission connection to the other parts of the system, means for controlling the operation of the subscriber station in response to received control signals and for transmitting data on the state of the subscriber station to the other parts of the system, and connecting means for connecting the peripheral device to the subscriber station. The subscriber station of the invention is characterized by comprising control means responsive to the received control signals to control and supervise the operation of the peripheral device connected to the subscriber station in response to the control signals.

The invention is based on the idea that the management of peripheral devices in a communication system will become easier and the costs are reduced considerably when the management system for the peripheral devices is integrated into the subscriber station management system. Thus, two parallel management systems are not needed in the communication system; the same management system can manage both the subscriber stations and the peripheral devices. Since the peripheral devices are in practice anyway in

connection with the other network parts by means of a subscriber station connected to them, and since the subscriber station management system still has to control and supervise said subscriber station, the subscriber station management system can with very slight changes also be utilised for controlling and supervising the operation of a peripheral device. In practice, the required change can be carried out by storing a management program in the memory of the subscriber station, by means of which program the subscriber station is able to control and supervise the peripheral device. A corresponding change is also made to the subscriber station management system, i.e. a new management program is stored therein. Thus, the subscriber station management system can control the peripheral device via the subscriber station.

The most significant advantages provided by the solution of the invention are thus the simplification of the network management system and the decrease in equipment costs, because the subscriber station management system and the management system for the peripheral devices can be integrated into one single management system. In addition, the situation can be avoided in which two separate management systems transmit control signals to the same subscriber stations, as a result of which the load in the network decreases. The invention also facilitates network reconfigurations, as instead of two separate management systems, the operator only has to make alterations to the subscriber station management system.

In a preferred embodiment of the system of the invention, a subscriber station to which a peripheral device is connected, comprises a WLL terminal with a memory in which a control program for managing said peripheral device can be stored. This preferred embodiment of the invention provides e.g. the advantage that the WLL terminal, which does not have a user interface (such as a telephone handset or a pushbutton dial plate), has a very simple structure, and thus its manufacturing costs are relatively low. When the management program designed for said peripheral device is stored in the WLL terminal, the additional advantage is gained that the implementation of the subscriber station management system on the network side is simpler than before. Thus, instead of having to make considerable changes to the subscriber station management system controlling and supervising peripheral devices according to the invention in order to manage said peripheral device, these changes can be made to the subscriber station. So, besides data on the state of the peripheral device and control commands, other data need not be

transmitted between the subscriber station and the subscriber station management system. In case of a potential defect in the peripheral device, the subscriber station takes the required measures according to the control program and only transmits data on the defect to the network control system.

The preferred embodiments of the method, radio system and subscriber station of the invention are disclosed in the attached dependent claims 2, 5 to 8 and 10 to 13.

In the following the invention will be described in greater detail with reference to the attached drawings, in which:

Figure 1 shows a block diagram of a prior art communication system,

Figure 2 shows a block diagram of a first preferred embodiment of the communication system of the invention,

Figure 3 shows a block diagram of a first preferred embodiment of the subscriber station of the invention, and

Figure 4 shows a flowchart of a first preferred embodiment of the method of the invention.

Figure 1 shows a block diagram of a prior art communication system. The system in Figure 1 can be e.g. a GSM system (Global System for Mobile communications). In Figure 1, the system in question serves both common mobile stations MS and stationary WLL subscribers 2 and 3. Stationary WLL subscribers refer herein to subscribers who are provided with all the other GSM network services except mobility. Thus, a home cell is usually assigned for WLL subscribers, which cell is the only radio cell belonging to the system, in which they can be used. Common mobile stations with unlimited mobility can naturally be used in any radio cell of the system in Figure 1.

Figure 1 shows a mobile services switching centre MSC, which is in connection with a home location register HLR maintaining subscriber data on subscribers MS and 2 to 3 within the system. The mobile services switching centre is also in connection with two base stations BTS1 and BTS2 via a base station controller BSC. Via said base stations, calls can be made from the subscriber stations MS and 2 to 3 e.g. to the subscriber stations of the fixed network PSTN (Publicly Switched Telephone Network).

The system of Figure 1 further comprises a repeater 5, by means of which the base station BTS2 can establish a radio link to the WLL subscriber station 3. In other words, the WLL subscriber station 3 is located in a shadow

area, and it is thus not able to communicate directly with the base station BTS2. On this account, the repeater 5 is tuned to repeat the traffic channels used by the base station BTS2 in such a way that the base station BTS2 and the WLL subscriber station 3 are able to communicate with each other.

In order for the operator of the system in Figure 1 to be able to manage the peripheral devices belonging to the system, a management system 6 for the peripheral devices is arranged to a maintenance centre 4 of the network. Said management system supervises the operation of the peripheral devices and, among other things, receives alarms from them when disturbances occur. For example in Figure 1, the management system 6 for the peripheral devices can comprise a computer unit transmitting status inquiries at regular intervals to the repeaters of the system according to a particular computer program. The repeater 5 receives such a status inquiry as control signals CNT2 proceeding from the mobile services switching centre MSC via the base station controller BSC to the base station BTS2, from where they are transmitted via the radio path to the repeater 5. Another situation in which control signals CNT2 are transmitted to the repeater 5 can be e.g. network reconfiguration, whereby the traffic channels of the base station BTS2 change, and the repeater 5 is commanded to change the frequencies of the channels repeated by it by means of the control signals CNT2. The repeater 5 can further be programmed e.g. to transmit measurement reports automatically at regular intervals, which reports are conveyed via the base station BTS2 to the network and further to the management system 6 of the peripheral devices.

Besides the management system for the peripheral devices described above, the maintenance centre 4 also comprises a management system 7 for the WLL subscriber stations. Said management system supervises and controls the operation of the WLL subscriber stations 2 and 3 in such a manner that potential malfunctions are observed as early as possible. This may e.g. be carried out such that at regular intervals, the subscriber station management system 7 transmits alternately to each of the WLL subscriber stations a call, to which the subscriber stations 2 and 3 are programmed to reply automatically. If a subscriber station does not reply, the management system 7 for the WLL subscribers interprets it in such a way that the subscriber station in question is not operating, after which it indicates an alarm concerning the subscriber station in question to the operator.

The management system for the WLL subscribers may also control

the operation of the subscriber stations 2 and 3. This may be necessary e.g. if a radio cell is congested. In such case, the subscriber station management system 7 can transmit a command via the control signals CNT1 to a subscriber station to proceed to another cell. This means in practice that the subscriber station is commanded via the control signals to use another radio cell for its connections, whereby the subscriber station locks onto the control channel of its new home cell. From the above description can be noticed that both the subscriber station management system 7 and the management system 6 for the peripheral devices load the base station BTS2, for instance, as both management systems transmit their own control signals CNT1 and CNT2 via said base station.

Figure 2 shows a block diagram of a first preferred embodiment of the communication system of the invention. The system in Figure 2 resembles closely the system shown in Figure 1. The system in Figure 2 differs, however, from the prior art system shown in Figure 1 in that the subscriber station management system 8 supervises and controls both the subscriber stations 2 and 3 and the peripheral devices 15. Thus, the operator maintenance centre 14 has no need of two separate management systems, but both the subscriber stations and the peripheral devices can be supervised and managed by one and the same management system 8.

In Figure 2, a WLL terminal 16 has been arranged in connection with the repeater 15. The subscriber station management system 8 supervises and controls the repeater 15 via control signals CNT3 transmitted to the WLL terminal. The structure of the repeater 15 is described in greater detail in Figure 3.

Figure 3 shows a block diagram of a first preferred embodiment of the subscriber station of the invention. The subscriber station 16 of Figure 3 can comprise e.g. a WLL terminal comprising a radio unit TRX and a memory 17, processing means 18 and an interface 19. In Figure 3, a peripheral device, i.e. the repeater 15, is connected to a bus 20 in said subscriber station (the subscriber station 16 can also be integrated into the repeater 15).

In Figure 3, the subscriber station comprises the interface 19, via which a program can be stored in its memory 17. The program can be stored e.g. in such a way that a maintenance person connects a portable computer to the interface 19, after which the program is transferred from the computer to the memory 17 via the terminal interface 19. The control program in question

is specifically designed for the peripheral device 15, i.e. the repeater. Unlike in Figure 3, a subscriber station can also be implemented in such a manner that the program is transmitted to the subscriber station via the radio path, after which the subscriber station stores it in the memory 17. In such case, a maintenance person is not needed to store the program in the subscriber station.

While in use, the processing means 18 of the subscriber station supervise and control the operation of said peripheral device 15 according to the program stored in the memory. The subscriber station 16 is thus able to e.g. receive alarms from the repeater 15. Having received such an alarm, the processing means 18 may transmit an alarm through the radio unit TRX to the subscriber station management system via the radio path. The subscriber station management system 8 and the radio part of the subscriber station 16 can communicate with each other e.g. by a data call or short messages. Data on the peripheral device connected to said subscriber station 16 is stored in the subscriber station management system, and so the subscriber station management system is able to handle the error code received from the subscriber station 16 correctly.

Correspondingly, the subscriber station 16 can receive via the radio unit TRX from the subscriber station management system e.g. control signals indicating that the frequency channels of the repeater should be changed. In such a case the processing means 18 of the subscriber station control the repeater via the bus 20 in such a manner that the frequency channels repeated by the repeater change to correspond to the new frequency channels assigned by the control signals of the subscriber station management system.

The subscriber station management system 8 may be programmed to transmit alternately to each WLL terminal within its area a call, by which it advises the subscriber stations to convey e.g. measurement results to the management system 8. Equally, the management system 8 sends such a call also to the subscriber station 16. As the peripheral device 15 is connected to the subscriber station 16, the memory 17 of the subscriber station 16 includes a program which makes the subscriber station 16 answer this call by transmitting to the subscriber station management system also data on the peripheral device 15. In case of a repeater, such data may be e.g. the frequency channels that are repeated by the repeater. The subscriber station management system is aware that a peripheral device is connected to the subscriber station, and thus it is also able to receive and handle data on the peripheral de-

vice.

Unlike in Figures 2 and 3, a peripheral device connected to a subscriber station can naturally also be some other peripheral device than a repeater. Other examples of peripheral devices are e.g. a burglar alarm, an anemometer and a surveillance camera.

Figure 4 shows a flowchart of a first preferred embodiment of the method of the invention. The flowchart of Figure 4 is applicable e.g. to the supervision and control of a peripheral device located in the coverage area of a mobile communication system.

In block A, a peripheral device is connected to a subscriber station. The subscriber station comprises preferably e.g. a WLL terminal, which does not comprise a user interface (such as a handset or a pushbutton dial plate) and whose costs are thus relatively low.

In block B, a program designed for controlling the peripheral device is stored in the subscriber station. Thus, the peripheral device is controlled and supervised to the largest possible extent by the subscriber station, and the number of control signals transmitted via the radio path can be minimized.

In block C, data is stored in the subscriber station management system indicating that a peripheral device is connected to the subscriber station. At the same time, a program for managing said peripheral device (by the subscriber station) is stored in the management system. Thus, the subscriber station management system is able to communicate with the subscriber station in such a way that the peripheral device can be controlled and supervised in the desired manner.

In block D, the peripheral device is controlled by transmitting control signals from the subscriber station management system to the subscriber station. The subscriber station in turn reacts to the control signals according to the control program stored therein.

It is to be understood that the above description and the related drawings are only intended to illustrate the invention. Consequently, although the invention has been described above specifically with reference to radio systems, it is also applicable in other connections, e.g. in a fixed telephone network. Variations and modifications of the invention will be apparent to a person skilled in the art without departing from the scope or spirit of the invention as defined in the appended claims.